

**HIGH-DENSITY PLASMA SOURCE FOR
LARGE-AREA CHEMICAL VAPOR
DEPOSITION OF DIAMOND FILMS**

Principal Investigator

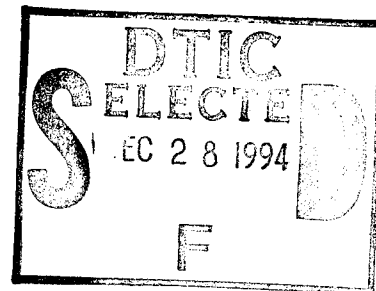
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Contract Dates: September 30, 1994 to March 30, 1995

Reporting Period: November 1, 1994 to November 30, 1994

Contract No. N00014-94-C-0199

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December 15, 1994

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MONTHLY REPORT

Overview

During this program Science Research Laboratory (SRL) and the Plasma Processing Group in the Department of Chemical Engineering at MIT are developing a large-area, directed plasma/atomic beam source for diamond deposition. The plasma source is based on an inductively-driven plasma accelerator that efficiently produces a high density (10^{14} - 10^{17} cm⁻³) plasma over an area of 0.1-1 m². The goal of this effort is to experimentally demonstrate the technical feasibility of employing the plasma source for high-throughput diamond deposition, through characterization of plasma parameters and preliminary diamond deposition experiments. A reactor design study will also be completed during Phase I, leading to an engineering design of a large-area plasma reactor for Phase II implementation. The period of performance is from 30 September 1994 to 31 March 1995.

November Progress

The preliminary activity during November was construction of the plasma beam reactor and diagnostics. The plasma reactor is based on an inductively-driven, large area plasma accelerator that is funded under a separate electric thruster program. Because of previous funding delay on that program, intensive effort was made to accelerate the construction of the plasma beam source. This plasma source consists of a 100-joule-per-pulse, 1 kilopulses-per-second driver, an inductive plasma acceleration coil, a gas handling system and a vacuum system. The pulsed driver, induction coil and vacuum electric feedthroughs are all currently under fabrication. Assembly and test of the system are scheduled to start from early January.

Major modifications to the experimental system to convert it to a plasma reactor include installation of a heated silicon/molybdenum wafer substrate for diamond deposition, an active cooling unit on the induction coil to allow high average power operation and plasma diagnostics for measuring critical plasma parameters. During November the design of the wafer substrate and a backplate that interfaces the wafer substrate and the plasma accelerator were completed. A first attempt to cast the cooling unit was made but the result was unsatisfactory because of incomplete detachment of the epoxy from the mold. The fabrication of a Rogowski coil, a magnetic probe, and a double Langmuir probe needed for plasma measurement were completed.

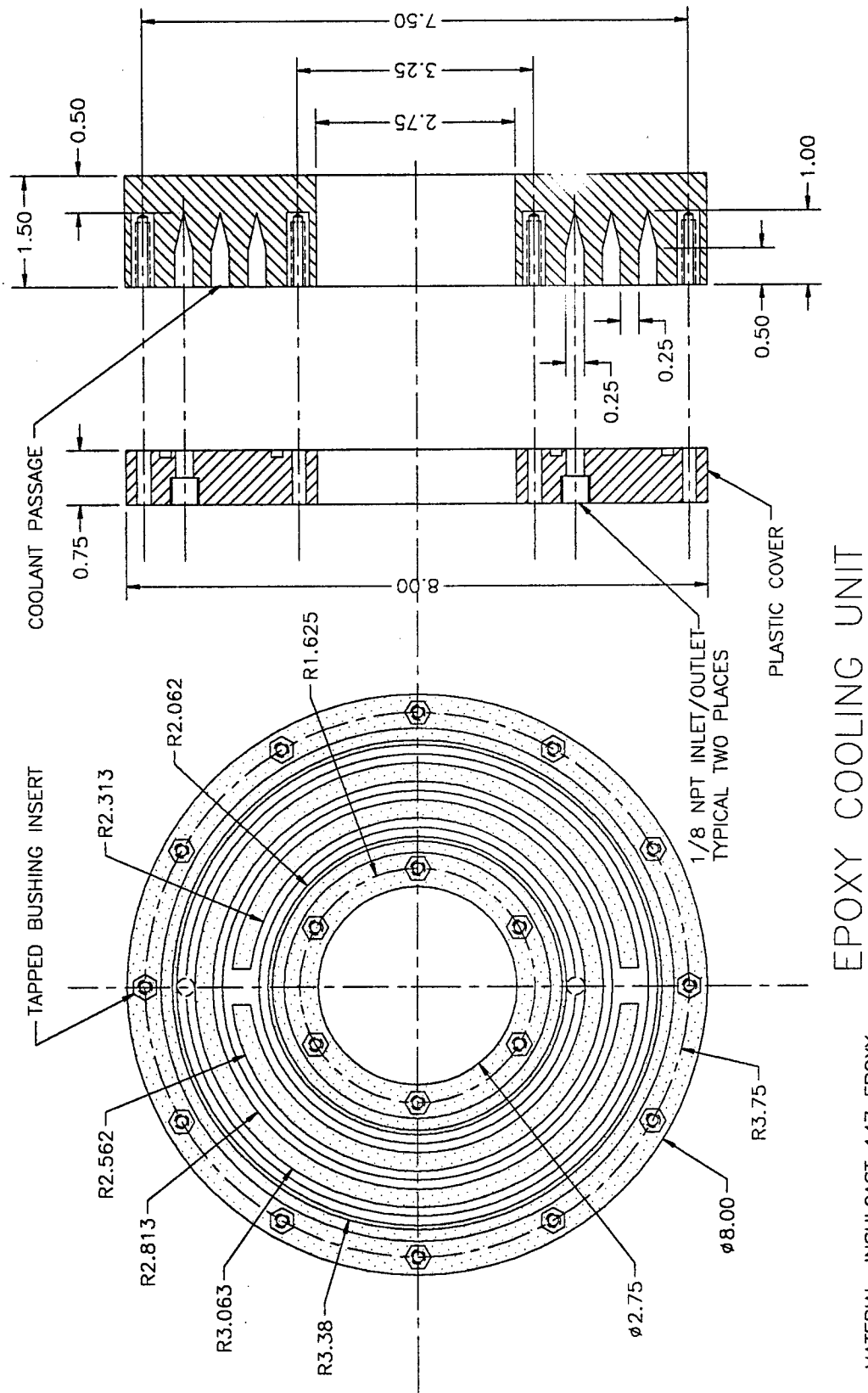


Figure 1